

## 5 CLAIMS

1. A method for simultaneously measuring ciliary beat frequency and metachronal wave frequency simultaneously in a sample of native epithelia or cell cultures, such method comprising the steps of:  
illuminating said sample with an illuminating light beam;  
10 detecting light backscattered from the sample surface with a microscope system; and  
analyzing the backscattered light with a real-time analysis system.
2. The method of claim 1 in which the illuminating light beam is laser light optically expanded to increase its focal depth.
- 15 3. The method of claim 1 comprising a further step in which the illuminating light beam is optically split by a beam splitter such that the transmitted beam is impinged on a piece of teflon and the reflected beam is directed along the excitation path of the microscope objective.
- 20 4. The method of claim 3 comprising a further step in which the reflected beam produced by the beam splitter is split by another beam splitter such that the reflected beam is directed to an eye-piece for visualization and the transmitted beam is focused by the  
25 microscope objective to the sample.
5. The method of claim 1 comprising a further step in which backscattered light from the sample and a random scatterer are mixed.

- 5     6.    The method of claim 5 comprising a further step in which the mixed light is collected by  
a photon counting photomultiplier tube.
7.    The method of claim 1 comprising a further step in which the signals emitted from the  
photomultiplier tube are analyzed to produce simultaneous measurements of  
10    metachronal wave frequency and ciliary beat frequency.
8.    The method of claim 1 in which the analysis to produce simultaneous measurements of  
metachronal wave frequency and ciliary beat frequency comprises the steps of:  
performing real-time time-scale wavelet transformation of the time series photon count  
15    data; and performing real-time Hilbert transformation of the time series photon count  
data.